DEVELOPMENT OF A MODEL OF SOIL CONSERVATION AND LAND AND SOIL JUDGING CURRICULUM MATERIALS FOR INTERACTIVE STUDENT LEARNING

HONORS THESIS

Presented in Partial Fulfillment of the Requirement for
the Degree Bachelor of Science in the College of
Food, Agricultural, and Environmental Sciences of
The Ohio State University

BY

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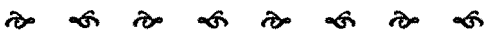

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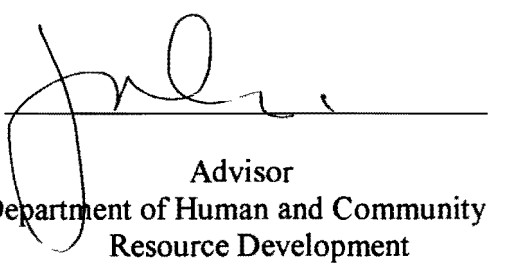

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DEDICATION

This achievement is dedicated to Debby Ebenhack and John and Vicki Niefer, who have been not only my guidance, but also my inspiration. Without the love and support of these individuals, the success of this project would not have been possible.

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I did not accomplish this tremendous achievement alone. Many individuals have given of themselves so that I could successfully complete this project. My sincere gratitude and appreciation does not give justice to the extraordinary efforts of the following people, the backbone behind my success:

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To John and Vicki Niefer, my parents, who have supported me throughout the duration of this project and celebrated this accomplishment with full enthusiasm.

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INTRODUCTION

Educators have long been searching for the most effective teaching methods, and now, with technology at our fingertips, educators are offered the opportunities of a whole new world: that of interactive multimedia learning. In fact, according to Shick (1996), as computers gain prevalence in society, educators have an obligation to plan and provide for the usage of computer technology within the classroom. Computers, telecommunications, and interactive multimedia cable are among the host of technological breakthroughs that have the potential to help educators reach higher standards within their classrooms (Technology and Education Standards, 1996). Computer-based technologies, in particular, bring immediacy and individualization to curriculum materials (Dyrli & Kinnaman, 1996). The use of a different set of resources also dictates what is perhaps one of the hardest aspects of advancement in any area: change in the way subjects are both taught and learned (Gregory, 1995). An increased use in computer courseware and other technologies has led to a few changes for medical student libraries across the country, among them choosing and evaluating instructional materials, as well as redefining the library's role in providing information to students to include aiding the navigation of the networks (Etter, 1995).

Using computers is nothing new to education. While it has more recently been emphasized, especially with the plethora of available online resources becoming readily available to educators and students alike, as early as 1972, research was being conducted at The Ohio State University regarding learning performance when a computer, to some degree, replaced the instructor.

In an introductory Agricultural Economics class at The Ohio State University, computer-assisted instruction was used as a replacement for the course lecture for a section of the course (Stitzlein, 1972). The course was chosen because of the level of difficulty students usually experienced in learning the material and aimed to increase the ease of learning (Stitzlein, 1972). The procedure seemed to relieve the instructor from much of the tedious drill, question-and-answer work, that accompanied the difficult material, thus freeing the instructor to individually assist students (Stitzlein, 1972).

Additionally, the rapid reinforcement of answers and self-regulated rate of advancement through the material were definite benefits of the program (Stitzlein, 1972). The computer program approached the material from three different angles—drill and practice, dialogue, and tutorial—and was designed as a more interesting approach to economics: by keeping the learner's attention and involvement at high levels (Stitzlein, 1972). The outcome was superior, or at least equal, to the progress for students using the computer versus those who did not (Stitzlein, 1972). Some students needed teacher interaction as a more integral part of their curriculum, implying that the computer program might not meet the students' learning needs (Stitzlein, 1972).

In related research, after using the achievement test scores of 144 Missouri students, microcomputer simulation was found to be as effective as the normal lecture/discussion method (McCaskey, 1989). Newcomb, McCracken, and Warmbrod (1988) defined lecturing as a "technique for disseminating factual information" and considered acceptable for information that only needed short-term retention on the part of the students (p. 105). Comparing a student's learning from a computer and from a lecture is thus roughly equivalent; the student will probably remember the material for at least a

short time. The comparison did not mention the quality of the lecture or the quality of the computer program.

While technology offers many possibilities for educators, technology does not solve all teaching-learning problems, and might not even be effective for use in some situations (Galliher, 1995). Unfortunately, not every school, whether a high school or a university, has access for all students to the equipment necessary to be able to use computer software programs frequently (Sutphin & Camp, 1990). In addition, computer instruction, *by itself*, does not take into account the complex areas of individual differences between learners, such as learning style, as implied by some of the findings of the Agricultural Economics computer program experiment mentioned previously (Stitzlein, 1972).

Learning style refers to the manner learners use to "sort and process information" (Cano & Garton, 1994, p. 6). A "style" is, according to Fischer and Fischer, "a quality that persists though the content may change" (Fischer & Fischer, 1979, p. 245). Style and method are extremely distinct from one another, method being a component that could be used with different styles (Fischer & Fischer, 1979). Gregorc points out that learning style also encompasses the behaviors that indicate how people learn and adapt to their environment (Gregorc, 1979, in Cano & Garton, 1994). According to the learning styles research conducted by Witkin, Moore, Goodenough and Cox (1977), two major learning styles can be identified (field-dependent and field-independent) on a continuum in which learners are at one extreme or the other, or somewhere in the middle. Field-dependent learners are more socially attuned than field-independent learners, utilizing many social skills with a true enjoyment of being with other people; additionally, field-

dependent learners have a more "globally experienced self" (Witkin et al, 1977). Field-dependent learners also exhibit a preference for the "spectator approach" to learning and a tendency to use the organization of information that's provided, as opposed to imposing structure no matter what (Cano & Torres, 1995).

Field-independent learners, on the other hand, are often perceived as more impersonal than their field-dependent counterparts: not only do these individuals have an impersonal orientation, but they also prefer abstract and theoretical approaches perceiving the individual pieces and parts as opposed to the big picture (Witkin et al, 1977). Also of interest is the observation that field-independent learners prefer "inquiry" and independent study while providing structure of their own in order to facilitate learning (Cano & Torres, 1995, p.2). In effect, a field-independent learner will be more internalized; that is, intrinsically motivated; while a field-dependent learner will be externalized and motivated by external sources (Witkin et al, 1977).

Why is this relevant? As cited by Whittington and Raven (1995), and supported by research, the consideration educators give to learning styles, and the learning style preferences themselves, are very closely related to learning achievement. Beyond the differences between how students of varying intellectual capacities learn in many differing ways, some students achieve only through self-selected methods of learning—what suits their needs and wants best, but doesn't necessarily meet the needs and wants of someone else (Dunn and Dunn, 1979).

PROBLEM IDENTIFICATION AND JUSTIFICATION

The National FFA Organization and educators involved with agricultural education and what was formerly referred to as "vocational agriculture," have often used curriculum materials as a means of preparing students for contests. Each year the Ohio Agricultural Curriculum Materials Service (CMS) releases a catalog packed with educational materials about everything from floral design to record keeping, with slide sets, manuals, and CD-ROM materials about various livestock animal breeds and plant science categories, but has yet to create equivalent materials for the area of soil conservation and soil and land judging.

With the recent announcement by the National FFA Organization regarding revising the Land and Soil Judging Contest, the CMS has considered how to revamp their materials to better serve students and teachers within the contest guidelines. Although the new judging parameters have not yet been released, the CMS wants their materials to be updated as much as possible so that the relatively simple terminology revisions can be inserted into a template or model of prepared information.

The Ohio FFA Association has approximately 20,000 members; of those, a great majority study the soils material as a part of their curriculum (Ohio FFA Home Page, 1998). Releasing new materials to help prepare these FFA members would potentially benefit all of these members, and ultimately the State of Ohio.

One of the biggest considerations the CMS must make is that of what *kind* of update they are going to make; should they keep the manuals with complimentary slides currently in circulation, or should they use a newer, more interactive multimedia option? The first part of this project's problem lies in this decision: to utilize the many resources

and opportunities available through multimedia sources—CD-ROM and the Internet, for starters—or to update the current materials in the format used now—primarily slides and manuals. At current cost, the materials used now are the most economical; however, with the price of redoing the slide sets, it would actually be around the same price to convert the information to a CD-ROM format (Waidelich, 1998). Before deciding how to conquer the conversion to a different format, though, the decision must be made as to whether or not changing the material to a newer, more interactive format would be beneficial for educators and students, and if so, what format to use from the many available.

The next part of this project's problem scope was concerned with *how* to integrate the information learners will need to know into the format chosen, depending on the previous decision of format type. For example, if the multimedia option was chosen, what kind of approach should be taken for learners to understand slope to the greatest extent? How can the information be presented for learners in order for the formatting choice to produce a worthwhile product?

STATEMENT OF OBJECTIVES

The first objective of this project was to research the relevancy and necessity of changing the current format, in regards to technology used, of the soil conservation and land and soil judging materials provided by the CMS in their catalog. The first objective was accomplished when the decision was made between using the technology available to produce a multimedia product and keeping the current format with revisions to the material included.

Secondly, this project aimed to develop a model for use in updating the soil conservation curriculum materials. The second objective was completed when the model was finished for the format type chosen.

The project also evaluated various educational tool formats in comparison with the Principles of Teaching and Learning as described by Newcomb, McCracken, and Warmbrod (1988) with the third objective. This objective was met with the compilation of Appendix 2: "Principles of Teaching and Learning for Various Educational Tools for Land and Soil Judging."

The outcome of the whole project will be a combination of a model or prototype of the possible finished product and a written report describing the processes used and justifying the approaches implemented. The goal of the model is to make the maximum use of learner knowledge and desire to learn, by presenting a prototype in the form of either a flow chart or a more interactive example involving slides or computer use.

PROCEDURE AND METHODS

I. Population and Sample

The study was descriptive and subjective as to the researcher. Evaluation of materials included 20 items (see Appendix 1: "Review of Materials in Determining Effective Formats for Land and Soil Evaluation Education") from the CMS catalog and assessed an assortment of items, from videos, to laboratory kits, to CD-ROM programs, slides and audio tapes. In addition, a college textbook was included in the evaluation because of information presented within the text that could be applied to the target audience of high school students.

II. Instrumentation

The project utilized subjective evaluation on the basis of (1) relevancy to material needed for successful participation in the contest, and (2) inclusion of general knowledge for the subject area. The Ohio Competency Analysis Profiles were used as a guideline, as well as a general knowledge of information needed for the soils and land judging contest. Evaluation techniques utilized references such as the Principles of Teaching and Learning (Newcomb, McCracken & Warmbrod, 1988) and the Rosenshine and Furst variables (Rosenshine & Furst, 1971).

III. Data Collection and Analysis

Evaluation of material was conducted by one researcher. In some cases, the researcher discussed opinions with other educators and used experiences from student teaching and some student input as to the final recommendations. Evaluation of the educational tool formats was conducted in a manner as consistent as possible with students in mind; for example, the CD-ROM evaluated was completed from the

standpoint of how a student would approach the material and the program. Final results are summarized in Appendix 2: "Principles of Teaching and Learning for Various Educational Tools for Land and Soil Judging," and Appendix 3: "Advantages and Disadvantages of Software Use as a Primary Learning Tool Format: A Synopsis of Research."

RESULTS AND DISCUSSION

I. How Objectives Were Met

a. Researching relevancy and necessity of changing format

First, it was found that a variety of formats for soils and land judging education were currently in use by the Curriculum Materials Service, as products offered for sale in their annual catalog. In order for an item to continue to be listed in the catalog, the item must sell at a certain level; thus, all of these items can be considered to be in fairly wide use, to some extent.

The formats most targeted to the contest specifics—as far as information contained, approach to evaluating land and scope—were slides and accompanying manuals. The slides and manuals focused more on actual land and uses, as opposed to some of the more science-oriented and subject-specific approaches found in other resources. The identified formats were also more tailored to the soils and land judging contest specifics, and the adaptation of a follow-through and flow from learning to application of knowledge was thus easy for both educators and students. Slides and manuals were, additionally, completely focused on soils as compared to some materials, which dealt with it as a chapter or section.

Based on the Principles of Teaching and Learning (Newcomb, McCracken, & Warmbrod, 1988), the computer or online program option had definite advantages in terms of interactivity. Many of the determinants of whether or not a particular Principle was met depended on a certain projection of how the material would actually be used in a classroom.

The decision made as a completion of the first objective was to take a "middle ground" approach. Rather than picking one or the other—keep the current or change completely—why not use the interest and interactivity advantages provided by technology to complement the basic information and applicability of the current formats?

b. Development of model and format choice

Because of the interactive nature and the broad range of versatility, a computer software or online-type format was chosen. The decision was based, in part, upon the recommendation of Will Waidelich, Director of the Curriculum Materials Service, on the basis that the CMS is lacking the equivalent material for the land and soil judging topics that is provided for other areas, for example, in the format of CD-ROM programs.

The computer or online program format was chosen for a number of reasons:

1. Interactive nature could leave students with many options as they were operating the program. Rather than being held back or forced forward to a set pace, students could operate at a level with which they are comfortable.
2. As opposed to a book or a tape, where involvement is a choice between visual and audio, on a computer program the involvement can be both, with narration to accompany written text and/or pictures.
3. Students could have more control in deciding the sequence of topics learned.
4. As far as assessment/evaluation, students could have instant feedback on correct and incorrect answers to questions.

5. Being able to set their own pace and make decisions about what's learned next gives the topic a higher level of meaning for the student.
6. The computer or online program format is catchier and perhaps more interesting than the traditional approach, thus serving to catch attention sooner and hold interest longer.
7. Although the student could have a high level of control in deciding the sequencing of topics, and whether they are even learned at all, ideally the program would be designed to direct the student to some extent in decision-making processes.
8. As an online option, the computer program would be available to students outside of the traditional classroom setting; it could be something they could access from their own homes.

The model was developed on the basis of what general information was needed because of current contest guidelines, in addition to information needed by students. In most cases these were synonymous. The model was also developed with a kind of web page set-up in mind, in which everything is inter-linked, which would allow the participant the highest amount of control possible. The model will be discussed in greater detail later, and can be referred to in Appendix 4: "Model for Effective Software on Land and Soil Judging."

II. Discussion of Findings

a. Review of materials

Twenty total items were reviewed, 19 of which were taken directly from the current CMS catalog; the other item was a textbook used at The Ohio State University for

the Soil Science 300.01 and 300.02 courses. Of the materials reviewed, 11 were written materials such as manuals or guides, one was a laboratory kit, one was a CD-ROM program with accompanying manual, three were videotapes, and four were slide sets.

The most current materials were dated 1996, and included Nature and Properties of Soils and the Ohio Vegetable Production Guide. The oldest materials, on the other hand, were dated 1986, including How to Grow Healthy Houseplants and Judging Land and Soil for Urban Use. The outcomes of the review of materials are summarized in Appendix 1.

b. 、 Principles of teaching and learning

The Principles of Teaching and Learning proposed by Newcomb et al (1988) have served as a basis for teaching agriculture. The Principles of Teaching and Learning are fundamental to effective instruction, and are outlined below, with the key words bold-faced. The key words will be bold-faced when referring to a specific Principle of Teaching and Learning.

The Principles of Teaching and Learning (Newcomb et al, 1988, pp. 25-44):

1. When the subject matter to be learned possesses **meaning, organization, and structure** that is clear to students, learning proceeds more rapidly and is retained longer.

2. **Readiness** is prerequisite for learning. Subject matter and learning experiences must be provided that begin where the learner is.

3. Students must be motivated to learn. Learning activities should be provided that take into account the **wants, needs, interests, and aspirations** of students.

4. Students are motivated through **their involvement in setting goals and planning** learning activities.

5. **Success** is a strong motivating force.

6. Students are motivated when they attempt tasks that fall in a **range of challenge** such that success is perceived to be **possible but not certain**.

7. When students have **knowledge of their learning progress**, performance will be superior to what it would have been without such knowledge.

8. Behaviors that are **reinforced (rewarded)** are more likely to be learned.

9. To be most effective, **reward (reinforcement) must follow as immediately as possible** the desired behavior and be **clearly connected with that behavior** by the student.

10. **Directed learning** is more effective than undirected learning.

11. To maximize learning, students should **"inquire into"** rather than be "instructed in" the subject matter. Problem-oriented approaches to teaching improve learning.

12. Students learn what they **practice**.

13. **Supervised practice** that is most effective occurs in a functional educational experience.

c. Principles of teaching and learning applied

Although the Principles of Teaching and Learning are fairly cut-and-dry principles, the formats leave room for influence by the instructor. Evaluations were made under the assumption that a very effective teacher was instructing the class, ie: a teacher who was using a problem-oriented approach as described by Newcomb et al (1988) and constantly striving to apply the Principles.

When the Principles are compared to various learning material formats, such as were evaluated here, a projection can be reached as to whether or not a given learning material format meets the Principles. A summary is in Appendix 2 and discussed below. The Principles are referred to by number, with the key words bold-faced.

- ***Experiments/Laboratories:*** Not only a broad scope but also wide applicability, giving educators the opportunity to use the laboratory or experiment to teach both basic hands-on concepts as well as the more difficult theories that might be harder for students to visualize.

    1. **Structure** and **organization** necessary for facilitation, **meaning** integrated from hands-on nature of activity.
    2. Students need to be at a certain point to understand the activity, so **readiness** is naturally implied.
    3. **Interest** of some students might be met, while the hands-on approach and verbalization of a vague concept could meet the **needs** of students; **wants** and **aspirations** negligible.
    4. Although feasible that students could **plan** out labs, for most intents and purposes not a general practice; usually labs are planned out and organized for students.
    5. Completion and understanding of the experiment could be synonymous with **success** in some or most cases.
    6. **Range of challenge** found in question-and-answer sections as well as in the application of ideas in conclusions and results interpretation.
    7. The **progress** of a lab/experiment naturally leads to building upon knowledge and with teacher to supervise this is increased.
    8. **Reinforcing** thought and concepts taught.

9. Depending upon set-up; if handed in for a grade, then might not be returned very quickly; in some cases one part must be correct before continuing, leading to a **more timely reinforcement**.
10. Usually in format with explanation, etc, lending **direction** to the learning process.
11. Very nature of experiment/lab is **inquiry**, although sometimes there is **instruction** necessary to accompany.
12. Lab/experiment is a kind of **practice** of procedures and of using knowledge and concepts.
13. This is met, assuming the students are **supervised** by a teacher.

- ***Field trips:*** Usually involves taking a trip somewhere, such as a tour or demonstration outside the typical classroom setting.
    1. **Organization** and **structure** not always present, but necessary for effectiveness; **meaning** found partly through application of material in different setting.
    2. Usually the reason for a field trip is that the material is relevant to the lesson; using this consideration, **readiness** would follow from the preparation before the field trip.
    3. Field trips offer higher **interest** partially because of a change in scenery; may also meet the **needs** of students who need a visual image of the material or **want** to visit the actual sites; **aspirations** being met is arguable.

4. Unless students are **involved** in initiating and **planning** the trip, the instructor is usually responsible for it; the idea, however, might have come from students, so this would be partly met.
5. While it might involve participation from students, it is doubtful that the traditional definition of **success** would be met; one could argue that learning or further understanding could be a form of **success**.
6. As above, while the field trip might involve activities with challenges, the traditional field trip would not necessarily meet a **range of challenge** with **possible but not certain success**.
7. Field trips measure learning more through an increased understanding of material than through a measurable learning method; might make learners increasingly aware of their **learning progress**.
8. Arguable; depends on circumstances.
9. Arguable; depends on circumstances.
10. Also depends on circumstances and facilitation, but implies **direction** if with a class and instructor for a specific purpose.
11. Many times on field trips, instruction will begin at an **"instructed in"** level and progress to **inquiry** as students ask questions deeper into material.
12. Arguable, but isn't really **practiced**.

13. Although **supervised**, the traditional field trip is not **practice**—the field trips that could be considered to be **supervised practice** will be found under a different learning material format.

- ***Handouts:*** Could be of anything, from text, to scorecard samples, to outlines of material to be taught, to homework assignments.

1. **Organization** and **structure** are met; maybe **meaning** because learner has their own copy to take home or to the site.
2. Instructor could take **readiness** into consideration, but material presented in and of itself in a handout usually does not.
3. **Needs** can be met for those learners who want their own copy to see and touch.
4. Unlikely that student **involvement** in material selection took place.
5. Negligible; usually are informative.
6. Depending on circumstances; if a question-and-answer type as more of an assessment, maybe more of a **range of challenge** likely than just the informative type.
7. Variable, depending on circumstances.
8. Depending on circumstances; **reinforcement** could come from using the handout as practice, but doubtful.
9. If something that's being handed in, possible to have slight delay in **reinforcement**; if just informative then not applicable.

10. **Directed** especially when instructor present to help it along.
11. More **instruction** than **inquiry**.
12. Depending on circumstances; arguable, usually informative.
13. If a take-home activity, then **supervision** would have to occur before or after working on it; if just informational then it is not **practice** at all.

- ***Judging/Contest:*** Involves the independent evaluation of a site for various usages as well as soil quality; team scores used in final choices for winning.
    1. **Organization** and **structure** in contest; **meaning** from the team side of it and from the investment of time into learning the material.
    2. Contest is written on basis of what learners should know, not for where each learner is at; therefore it is the responsibility of each learner to reach the point of **readiness** so as to be prepared for the contest material.
    3. **Wants** met through the competition/winning and the feelings of accomplishment associated with that; **needs** met in the application of information; **interests** maybe and **aspirations** arguable.
    4. Students could be **involved in setting goals** as far as placing, team effort, scores, etc; done on smaller level than whole contest, activities already integrated into whole contest.

5. Definitely room for **success**, as far as team and individual placings.
6. **Range of challenge** found because don't know what will be asked or how hard it will be, etc.
7. **Knowledge of progress** after scores are released or if look answers up after the contest.
8. Practice is found through the set-up of the activity; students use the very material learned, thus **reinforcing** it.
9. Scores and placings received usually within a day or two, which could be an **immediate reinforcement**, depending on the number of contestants and the number of evaluators/judges/graders.
10. **Directed** because there is a definite set of knowledge to know and a set of procedures to use.
11. Arguable; usually a mix of basic **instruction** fueled later by student **inquiries**.
12. Definitely **practice**.
13. Instructor is usually the coach; if not then older student or expert in the field is coaching along for guidance and **supervision**.

- *Lecture:* Involves passing information from the teacher/lecturer to the students through telling them factual information, such as giving oral

directions, suggestions or introductory comments (Newcomb et al, 1988).

1. **Organization** and **structure**, depending on teacher; **meaning** is possible but considered negligible here.
2. Assuming teacher knows where learners are at on the continuum of learning.
3. Perhaps **interests**, depending on student and material; maybe **needs** of students who prefer to hear the material presented before seeing it or putting it to use; negligible on **wants** and **aspirations**.
4. Usually students just listen; even when activity involved, most of the time learners not given opportunity to be **involved with setting goals and planning** for the lecture.
5. Usually nothing to **succeed** at, except listening.
6. Attending/listening to lecture not an activity, nor does it have a **range of challenge** at a tangible level.
7. Perhaps if short assessments interspersed for informative purposes.
8. Doesn't really require **reinforceable** behavior except listening and taking notes.
9. Praise for a correct answer could be an arguable example.
10. Definitely; teacher is leading the students in a **direction** toward achieving the knowledge of the lecture.

11. Arguable; highly dependent on teaching style, although usually more **instruction** than **inquiry**.
12. In typical lecture, not really **practice**, but listening and learning.
13. Could take place practically anywhere with **supervision**, but not really **practice**.

- ***Manuals/Textbooks:*** Often a convenient resource from classroom to field because of the information contained within a relatively small area; offer a supplement to other learning tool formats and can stand alone as a source of reference.
    1. **Organization** and **structure** usually present; different with different author, publisher, etc; **meaning** negligible.
    2. Usually does take into account a certain level or beginning point, ie, high school versus college level; non-negotiable, meaning **readiness** varies with the individual learner.
    3. **Needs** met through the explanation in written form.
    4. Student **involvement** more from standpoint of what chapter to read as opposed to what information is included in chapter; up to teacher to involve students in this aspect if using this format.
    5. Maybe room for **success** with some activities within text or manual, but as a whole **success** would be in reading it and knowing it.

6. Tasks might be included in book; book itself not really a **range of challenge**.
7. Depending on circumstances, doesn't really provide for a **progress** up-date; maybe in review section at end of chapters.
8. Hard to find, negligible if present.
9. Answers to some questions might be in book, ie, in the back in a special answers section, so student could look them up and get **immediate reinforcement** or feedback; if turned in there's a typical lapse.
10. Leads learners to material; provides **direction**.
11. Provides more **instruction** than **inquiry**; **inquiry** would be instructor's responsibility.
12. **Practice** might be found in activities within the book.
13. Reading probably done at home, although might be in school with **supervision**.

- ***Online:*** Although as of the date research was completed no known online resources were known of, it would ideally consist of interactive, inter-linked sites students could choose from, deciding upon their own path of learning. The sites would also include frequent assessments and practice activities.

1. **Organization** and **structure** very necessary for success, while **meaning** somewhat integrated through use of computers and different setting and approach.

2. Although not available yet, could have different levels to meet the **readiness** needs of students with various levels of knowledge; assume no knowledge and start at most basic level.
3. **Needs** met in the hands-on, interactive and exploratory nature of format; **interests** met through the interactive and exploratory use of computer; **wants** met possibly through using computer.
4. Students would **plan** their own path of learning; choosing what topic to see first and how much to see.
5. Navigating program successfully could equal **success** to students; remembering material could be easier.
6. Depending on facilitation; if had constant assessments with different levels addressed.
7. Depending on facilitation; if know that moving on depended on knowing; if test/evaluation at end is scored, etc.
8. Correctly navigate and remember information that would be reinforced at end if an evaluation that learner did well on; or if moving on depended on correct answers to questions.
9. **Reward** would be pretty much instant and could include an explanation of why correct/incorrect.
10. Organization and structure dictate that the learning will be **directed**; even though choices available, tailored to lead certain ways.

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1. **Organization** and **structure** very necessary for success, while **meaning** somewhat integrated through use of computers and different setting and approach.

2. Although not available yet, could have different levels to meet the **readiness** needs of students with various levels of knowledge; assume no knowledge and start at most basic level.
3. **Needs** met in the hands-on, interactive and exploratory nature of format; **interests** met through the interactive and exploratory use of computer; **wants** met possibly through using computer.
4. Students would **plan** their own path of learning; choosing what topic to see first and how much to see.
5. Navigating program successfully could equal **success** to students; remembering material could be easier.
6. Depending on facilitation; if had constant assessments with different levels addressed.
7. Depending on facilitation; if know that moving on depended on knowing; if test/evaluation at end is scored, etc.
8. Correctly navigate and remember information that would be reinforced at end if an evaluation that learner did well on; or if moving on depended on correct answers to questions.
9. **Reward** would be pretty much instant and could include an explanation of why correct/incorrect.
10. Organization and structure dictate that the learning will be **directed**; even though choices available, tailored to lead certain ways.

11. Moderate amount of **inquiry** in deciding which avenue to pursue; **instruction** involved but integrated.
12. Some level of actual land judging could be facilitated online through pictures with scorecards.
13. Although available to students outside class, the online program could act as its own **supervisor** somewhat, regulating where student went and communicating scores and progress.

- ***Oral reasons:*** Preparing an oral defense or reasoning strategy to explain viewpoint to judges or teachers.

1. **Organization** and **structure** provided by instructor when teaching how to do; **meaning** because investing part of self in the presentation.
2. Can only present from where you're at; can only tell as much as you know, so it's very flexible as far as where learner starts at; by the end, everyone should be at same place.
3. **Needs** met because some people do better explaining to others and need to explain to truly learn; **interests** and even **aspirations** could be met through the extension of the soils topic to include public speaking as well.
4. Very high **student planning**: students decide how extensive, what to say, how well they will do, approach, etc.

5. When achievement is perceived on the part of the student, from doing a good job to receiving a high score, **success** will be present.
6. Definite **range of challenge**; don't know what circumstances will provide for you, ie, will you know the information when you most need to.
7. Possible to know score right after; depends on if a contest or just a class technique.
8. Evaluation usually filled out, describing good and bad points, serves as a **reinforcement**.
9. Length of time for reward varies, but usually evaluated promptly after evaluation.
10. Provides **direction** because everyone has a goal/end result to try to reach.
11. When not sure of something, will have to ask to find out; thus encouraging **inquiry**.
12. Definitely **practice** in demonstrating knowledge.
13. Instructor or an expert of some type usually present.

- ***Overheads:*** Useful in presenting information and serving as a supplement to other resources; often provide basic information that can be quickly displayed, through use of an overhead projector, to an entire class of students.

1. **Organization** and **structure** necessary for neat appearance; might add **meaning** for learners to see it as opposed to just hearing about it.
2. Usually teacher will take **readiness** into consideration, but the material presented in an overhead in and of itself does not.
3. **Needs** met for those who need to see the information versus just hearing about it.
4. No real **learner involvement** for overheads; maybe on filling it out if blank with questions or fill-in and label items.
5. Negligible.
6. Possible but highly unlikely from traditional standpoint.
7. Depending on circumstances, but with just an overhead, students probably would not have knowledge of progress.
8. Encouragement from instructor possible; overall unlikely from the format.
9. If a fill-in, **reinforcement** from instructor would probably be pretty instant because would be working together to fill it out, but generally, no.
10. **Directed** with respect to teacher and instructor use; in and of itself would be variable.
11. Would depend on instructor and circumstances; traditional view would be to say no.
12. Arguably could be **practice**; more often it is instruction.

13. If **practice**, usually **supervised**; but not usually practice.

- ***Peer mentoring:*** Involves one student teaching material to another student, whether older or just more experienced in the area; generally teaches an equal amount to both individuals. Not necessarily just instruction, also demonstration and showing as consequences; happens often in less formal format than discussed here.

    1. **Meaning** because coming from nontraditional source as a teacher and different from usual circumstances; **structure** and **organization** might be negligible depending on teacher involvement.
    2. Student acting as mentor will start where they're comfortable; key to pair with student at distinguishable level; at some point they could learn at higher level together.
    3. **Needs** met for learners who desire personal attention, social atmosphere, communication in their "own language"; **interests** and possibly **aspirations** met for mentors who enjoy what they are teaching.
    4. Very high, both for student acting as mentor—planning activities, approach, how to explain, and for learner—what material needs covered.
    5. **Success** is highly imminent if both students committed with instructor to direct slightly; success for mentor in getting point across; success for learner in understanding.

6. Definite; don't know how you'll do as a teacher/mentor; don't know how teacher/mentor will do teaching you.
7. With instructor interaction, can keep on-target; frequent assessments by all three parties—mentor, learner, and instructor, would keep **knowledge of progress** high.
8. Encouragement is found from success, which also serves as **reward**; sense of achievement for both parties thus **reinforcing** the material.
9. Arguable, depending on circumstances; probably pretty quick because if a one-to-one situation then could talk about things in-depth as needed.
10. Especially if with instructor aid—have definite goal in sight, ie, learning material, contest score, etc, and plan to get there.
11. Depending once again on circumstances; mentoring could at some points depend on the questions asked by the learner to not only give initial direction but also to continue on.
12. Mentor will especially know material because of **practice** in teaching it to someone else.
13. Usually instructor interaction and **supervision** involved.

- ***Slides:*** Common preparation for soils and land judging contests because of the ease of demonstrating the concepts visually, using a slide projector. Usually include both color photographs of various sites as well as informational slides with key terms and definitions.

1. **Organization** and **structure**, although **meaning** could be negligible depending on how often slides used for other contest preparation.
2. Slides are arranged and taken usually before learning starts; bought in a set; usually just pop in the tray from last year's class—everyone sees the same slides so not as personalized for each learner's needs.
3. **Needs** met for learners who want to see the material visually.
4. Students might request to see slides, but usually an executive decision of instructor, another one is the choice of what slides; no room for students to really have a hand in it.
5. Can succeed in identifying things from slides, but not really an activity/format that encourages high **learner involvement**; depending on circumstances.
6. Again depending on circumstances; usually **range of challenge** only exists the first time through the slides, on repeated viewing, lower challenge.
7. Unless accompanied by a manual, might not know for sure if assessment is correct; **knowledge of learning progress** could be low; looking at pictures could be argued to be only effective to a certain point as far as learning progress is concerned.
8. Might get encouragement from instructor on getting slide identified correctly; overall no.

9. Depending on circumstances; although usually if an evaluation, would be collected and then a delay before feedback on answers.
10. Definite **direction**.
11. More **instruction** than **inquiry** when slides used alone; much depending on circumstances.
12. Could be viewed as a type of **practice**.
13. Probably definitely going to be done in educational setting, teacher presence could be variable.

- ***Software:*** Expected to be highly interactive and make use of student creativity; could be formatted to be a simulation game or a series of inter-linked pages, allowing students the ability to choose their own progress and topics.
    1. **Organization** and **structure** are necessary for any kind of success with software; **meaning** possible because of high usage and enjoyment of students in using computers.
    2. For a software program to be successful, must be at a level learners can relate with, or they won't use it; usually assume only the most basic knowledge, sometimes not even that, and offer set-own-pace option.
    3. **Needs** through hands-on, **wants** and **interests** through atypical approach.

4. Because of choice of paths, learner has great deal of say in what happens next on project even though it comes prepared to use.
5. After learning how to work program, possible to achieve high **success** in learning and usage.
6. Many activities on computer programs can be at different levels, thus meeting needs of students at varying learning levels, therefore **range** making success **possible but not certain**.
7. Because in some cases can't advance until understand certain concept or answer questions correctly.
8. **Rewarded** in being able to move on.
9. Instructor feedback on correctness of answers, also being allowed to move on.
10. Stemming from very high organization and structure, **direction** goes hand-in-hand.
11. Highlighted words that can be clicked on for more information; interactive activities.
12. Frequent assessment activities equal practice; practice judging, scorecard.
13. Not always, but usually software would be on school's computer with **supervision** readily available.

- ***Soils pits:*** Utilized during soils and land judging contests; consists of a large hole dug in the ground in which students walk down into in order to evaluate various aspects about the soil and the site itself. Many times a pit is used as a hands-on experience to further demonstrate soil properties and other concepts as discussed.

    1. Exhibits **structure, organization** and **meaning**.
    2. Depending on facilitation; with traditional set-up, students learn the basic facts and then go into the soils pit.
    3. **Needs** met for hands-on learners; **interests** and **wants** perhaps touched on.
    4. Depending on situation; most cases no.
    5. If students successfully apply information.
    6. Depending on learner and cognitive level taught at; overall, yes.
    7. Possible; not always guaranteed; usually teacher nearby to inform students of **learning progress**.
    8. Use of simple praise could accomplish this.
    9. Depending on whether supervised or not; usually after students judge in the pit, an explanation from the supervisor—judge or teacher—ensues, thus leading to **immediate reinforcement**.
    10. Definite **direction**.
    11. Highly arguable; this is open for use of **inquiry** depending on teacher.

12. Definitely a **practice** situation.

13. Teacher or coach usually present to **supervise**.

- ***Videos:*** Using a TV set-up, videos can accomplish demonstrating concepts and impacting the lesson through the use of both audio and visual means. Often used as a supplement for lecture and an activity to enhance understanding of seeing-is-believing concepts, such as particle size.

    1. **Structure** and **organization**; **meaning** negligible.
    2. In and of itself doesn't take into account individual students, although could be geared one way or the other.
    3. **Needs** met for those preferring seeing and hearing at same time.
    4. Depending on circumstances; no real **student involvement** in organizing material to be presented.
    5. **Success** not really an option depending on circumstances and format; if a mini-contest then could be an option.
    6. Depending on circumstances and format/content, no.
    7. Depending on circumstances; traditionally no.
    8. No real behavior to **reward** unless a contest on video.
    9. Depending on circumstances would be variable in length.
    10. Gives learners a basis and typically has a specific order of events, lending to **direction**.
    11. More **instruction** than **inquiry**.

12. Room for it to be a **practice**; usually informative.
13. Probably **supervised** from stance of being in a classroom.

- ***Written evaluation:*** Often the major emphasis of evaluation of learning is through written means; is adaptable enough to be coupled with a judging contest or other formats. Can be extremely useful in guiding students as to what information is important.
    1. **Structure** and **organization**; **meaning** negligible, could vary.
    2. Depending on when written, usually takes into account where learner should be instead of where they're actually at.
    3. Could use **needs** and even **wants** in determining different styles of questions and approaches to evaluation, although these are not usually a significant factor overall.
    4. Depending on circumstances; mostly no.
    5. **Success** could be achieved through high score or meeting goal.
    6. If written well to truly evaluate, then yes to **range of challenge**.
    7. If high score then good **learning progress**; if low score then poor progress.
    8. Reinforces important ideas and concepts; shouldn't be first time for **reinforcement**.
    9. Takes time to grade, although could have other students grade in class.

10. Assumes followed original direction and continued along with where instructor was going.
11. More **instruction** than **inquiry**.
12. In effect it is **practice**, but arguably of a more serious note or tone.
13. Unless a take-home, would be **supervised**.

d. Advantages and disadvantages of software

Using software as a primary learning tool format presents both advantages and disadvantages from an educational—whether a student or a teacher—standpoint. The advantages and disadvantages are summarized in Appendix 3: "Advantages and Disadvantages of Software As a Primary Learning Tool Format: A Synopsis of Research."

Software holds a key advantage in that it requires an active response by the student, even if it is just a typed answer to a question (Stitzlein, 1972). Because of the highly interactive nature of computer programs, especially when compared with many of the other formatting options, Stitzlein (1972) argues that students' attentions are kept longer and involvement is higher. The many increases in desirable student response is probably a direct result of the increased opportunity to make choices and direct a unique approach to the subject material (Stitzlein, 1972), as well as the option of learning by doing, as found with the Dutch erosion simulation game, which demonstrates the erosion-agriculture relationship in a developing country (Beishuizen, 1992). The Agricultural Education SimFarm™ program supplied by the Oklahoma Department of Vocational and Technical Education applies a similar philosophy, teaching students the basics of

operating a farm system through a game scenario (1995). "China Connection," a computer simulation game in which student teams experience simulated travel through four cities in China, was designed to encourage higher thinking skills and greater global understanding (Fulbright, 1984).

Speed of progress is not as relevant with computer programs because of the ability of the computer program to adapt to the pace of the user (Stitzlein, 1972). Software also gives information to both students and teachers regarding their progress, because the computer can process the correct or incorrect answer and reply with nearly instant reinforcement (Stitzlein, 1972). The efficiency of computer software programs lends a distinct quality of immediacy to the material, while the personalized features, such as name use and ability to make choices, extend individualization (Dyrli, 1996). The individualization of instruction allows the program to match student level of achievement, interest, and/or ability (Stitzlein, 1972).

Bringing the outside world into the common classroom and obtaining resources beyond what would normally be available is a definite excitement surrounding computer software programs (Technology & Education Standards, 1996). However, access to equipment and funding might not be available for many schools, and thus students (Sutphin & Camp, 1990). Beyond the cost aspect of technology, lack of training and incentive could also block application (Miller & Doerfert, 1995). Instructor and student comfort coupled with computer technology causes a high level of computer anxiety, yet another deterrent keeping programs from wider applications in the education setting (Shick, 1996).

From an educator's viewpoint, computer applications within schools presents a new field for students to take advantage of the system, such as abuse of online privileges (Miller & Olson, 1995). While the novelty of computer use might still win educators over, research has shown it to be only as effective as the lecture/discussion method (McCaskey, 1989).

e. Model for effective software

The model developed, found in Appendix 4: "Model for Effective Software on Land and Soil Judging," is a very general outline of the outcome of the research completed. Ideally, the model would be applied to eventually become either a CD-ROM program or an online program for soils and land judging education. A program such as this could be used by educators, as a resource for lessons in this topic heading, or by students themselves, in training for land and soil judging contests or studying.

The model is designed as a flowchart, with the main headings—"Introduction," "Slope," "Texture," "Land Usage," "Soil Properties," and "Evaluation"—serving as the initial links into the topic area. As visualized by the researcher, the headings could be presented on the initial screen after the credits of the program, and each heading could serve as a "link" to another "site" within the program. After "clicking" on a heading, a student would be transported to a screen that would present the choices within the heading—the subheadings branching from under each main heading when referring to the flowchart in Appendix 4. The student would then click on one of the choices and move on to a screen presenting information about the topic chosen. Through a method of choosing their own path through the program, each student is experiencing **involvement in setting goals and planning learning activities**.

The use of color, narration, and attractive formatting within each screen is of utmost importance for the program to be utilized to its fullest capacity. A variety of activities should be planned within each topic, with frequent assessments included. In addition, techniques such as a "clickable glossary" should be utilized as much as possible; in which students can click on highlighted words, or words that are in designated colors, and link up with a screen of information about the selected word or concept. A technique such as a clickable glossary allows students to **"inquire into"** the information, as opposed to relying on pure instruction.

A program that is going to be used by many students, of differing levels, needs to also provide flexibility for both (1) the students who have a wide base-knowledge of the material and also (2) the students who have only very scarce knowledge. Providing an "Introduction" heading serves to accommodate the beginning level student. On the other hand, offering options such as "Practice," under the "Slope" heading, and "Sample Contest," under the "Evaluation" heading, meets the needs of a more advanced student, not only continuing to provide them with a **range of challenge** and **supervised practice**, but also taking into account the level of **readiness**.

The topics provided as a rough outline for a software or online program by no means consider the many possibilities and approaches for soils and land judging education. In addition to the headings and subheadings shown, sub-subheadings could also be attached; however, allowing too many options can decrease the effectiveness of a program (Waidelich, 1998).

III. Recommendation

As mentioned previously (see Introduction), computer instruction, *by itself*, does not take into account individual learner differences. This can be related to the Roshenshine and Furst variable of variability (Rosenshine & Furst, 1971). While a computer program might be highly interactive and extremely verstile, the fact remains that it is rather limited—after all, it is stationary and removed from some of the actual field sites and experiences that could arguably be needed for instruction in the soils area. In addition, a computer program has limited interaction with actual people. As found by Witkin et al (1977), a field-dependent type of learner likes to be with people, and a computer-related program, *by itself*, does not involve the social interaction preferred by this learning style.

The recommendation that a computer or online program be *integrated* into a curriculum, as opposed to being used as a solitary resource, logically follows from the argument presented. While computer and online programs have been shown to take into account virtually all of the Principles of Teaching and Learning in one fashion or another (see Appendix 2), the evidence presented in Appendix 3 presents a clear case against making a complete move to reliance on computer and/or online programs.

The key to effective soils and land judging education, as summarized through the research conducted, is utilizing a variety of tools to meet the Principles of Teaching and Learning in as complete a manner as possible. When utilizing a soils pit, for example, a teacher might also use peer mentoring because peer mentoring includes **learner involvement in setting goals and planning** while soils pits do not necessarily meet the Principle as completely. Also important to note is the flexibility in styles of teaching:

any of the mentioned educational tools could be adapted through application by educators. Needs of the different learning styles of students should also be considered for the maximal learning and effectiveness of the material to be met.

More research is needed in the area of computer applications, considering the scenario of computers as primary learning tools. Although the evaluation of materials presented in Appendix 1 contains a variety of different formats and approaches to the topic area, more materials need to be evaluated. When these materials are evaluated, the researcher recommends the development of an assessment instrument for a more objective evaluation of the usefulness of materials. Materials need to be evaluated not only on their content, but also on their projected application ranges, as well as the popularity among educators who are actively involved with teaching the subject area.

Furthermore, a wider range of materials needs to be reviewed, taking into account materials offered by sources other than the Ohio Curriculum Materials Service. Although the CMS has a relatively broad range of materials available, limiting the evaluation to just the products available through their catalog narrows the scope and applicability of the research to some extent. Involving a variety of educational professionals from across the United States and beyond, also offers exciting possibilities for creative new ideas and approaches to the material, as far as application of materials, understanding of the content area, and availability of resources are concerned.

REFERENCES

"Agriculture Education SimFarm™." (1995) Technology Learning Activity, Teacher Edition. Oklahoma State Dept. of Vocational and Technical Education, Stillwater. Curriculum and Instructional Materials Center. ERIC Document Reproduction Service: No. ED383934. Internet address: http://136.242.172.58/db/riecije/ed383934.htm.

Beishuizen, J.J. (1992) "Studying a Complex Knowledge Domain by Exploration or Explanation." Journal of Computer Assisted Learning. 8(2):104-117. ERIC Document Reproduction Service: No. EJ447562. Internet address: http://136.242.172.58/db/riecije/ej447562.htm.

Cano, J. & B.L. Garton. (1994) "The Relationship Between Agricultural Preservice Teachers' Learning Styles and Performance in a Methods of Teaching Agriculture Course." Journal of Agricultural Education. 35(2):6-10.

Dunn, R.S. & K.J. Dunn. (1979) "Learning Styles/Teaching Styles: Should They...Can They...Be Matched?" Educational Leadership. 36(4):238-244.

Dyrli, O.E. & D.E. Kinnaman. (1996) "Gaining the Online Edge. Part 2: Energizing the Classroom Curriculum through Telecommunications." Technology and Learning. 16(4):65-70. ERIC Document Reproduction Service: No. EJ518529. Internet address: http://136.242.172.58/db/riecije/ej518529.htm.

Etter, Z.C. (1995) "Impact of Curriculum Revision on Media Collection." Special Libraries. 86(2):83-90. ERIC Document Reproduction Service: No. EJ501821. Internet address: http://136.242.172.58/db/riecije/ej501821.htm.

Fischer, B.B. & L. Fischer. (1979) "Styles in Teaching and Learning." Educational Leadership. 36(4):245-254.

"Fulbright Hays Summer Seminar Abroad Program: Curriculum Projects." (1984) ERIC Document Reproduction Service: No. ED340644. Internet address: http://136.242.172.58/db/riecije/ed340644.htm.

Galliher, R. (1995) "Preparing Technical Educators for Interactive Instructional Technologies: A Review of Research and Practice." ERIC Document Reproduction Service: No. ED392997. Internet address: http://136.242.172.58/db/riecije/ed392997.htm.

Gregorc, A.F. (1979) "Learning/Teaching Styles: Potent Forces Behind Them." Educational Leadership. 36:234-236.

Gregory, D.C. (1995) "Art Education Reform and Interactive Integrated Media." Art Education. 48(3):6-16. ERIC Document Reproduction Service: No. EJ510833. Internet address: http://136.242.172.58/db/riecije/ej510833.htm.

McCaskey, M.J. (1989) "Assessing the Effect of Computer Assisted Instruction." Journal of Studies in Technical Careers. 11(2):119-130. ERIC Document Reproduction Service: No. EJ397421. Internet address: http://136.242.172.58/db/riecije/ej397421.htm.

Miller, G. & D.L. Doerfert. (1995) "Teaching through Fiber-Optics Telecommunications Technology: Possibilities and Priorities for Agriculture." Iowa Communications Network. Proceedings of the 1995 Annual Convention of the Association for Educational Communications and Technology. ERIC Document Reproduction Service: No. ED383328. Internet address: http://136.242.172.58/db/rieije/ed383328.htm.

Miller, L. & J. Olson. (1995) "How Computers Live in Schools." Educational Leadership. 53(2):74-77. ERIC Document Reproduction Service: No. EJ513406. Internet address: http://136.242.172.58/db/riecije/ej513406.htm.

Newcomb, L.H., J.D. McCracken & J.R. Warmbrod. (1988) Methods of Teaching Agriculture. Danville, IL: The Interstate.

Ohio FFA Association Home Page. (1998) Internet address: http://www.ohioffa.org/whatis.htm.

Rosenshine, B. & M. Furst. (1971) "Research on Teacher Performance Criteria." In B.O. Smith (Ed.). Research in Teacher Education: A Symposium. (pp. 27-72). Englewood Cliffs, NJ: Prentice Hall.

Shick, R.W. (1996) "Implementation of Technology in the Classroom." MS Thesis. Nova Southeastern University. 75 pp. ERIC Document Reproduction Service: No. ED394516. Internet address: http://136.242.58/db/riecije/ed394516.htm.

Stitzlein, J. (1972) "The Use of Computer-Assisted Instruction in Teaching Agricultural Economics." MS Thesis. The Ohio State University. 89 pp.

Sutphin, H.D. and W.G. Camp. (1990) "A Model for Building Consensus on the Applications of Microcomputers in Agricultural Education." 15(3):65-79. ERIC Document Reproduction Service: No. EJ426615. Internet address: http://136.242.172.58/db/riecije/ej426615.htm.

"Technology and Education Standards. Issue Brief." (1996) ERIC Document Reproduction Service: No. ED394518. Internet address: http://136.242.172.58/db/riecije/ed394518.htm.

Torres, R. M. & J.Cano. (1995) "Critical Thinking as Influenced by Learning Style." Journal of Agricultural Education. 36(4):55-63.

Torres, R.M. & J. Cano. (1994) "Learning Styles of Students in a College of Agriculture." Journal of Agricultural Education. 35(4):61-66.

Waidelich, W. (1998) Director. Ohio Curriculum Materials Service. The Ohio State University, Columbus, OH.

Whittington, M.S. & R. Raven. (1995) "Learning and Teaching Styles of Student Teachers in the Northwest." Journal of Agricultural Education. 36(4):10-17.

Witkin, H.A., C.A. Moore, D.R. Goodenough & P.W. Cox. (1977) "Field-Dependent and Field-Independent Cognitive Styles and Their Educational Implications." Review of Educational Research. 47(1):1-64.

LIST OF APPENDICES

APPENDIX I:

REVIEW OF MATERIALS IN DETERMINING EFFECTIVE FORMATS FOR LAND AND SOIL EVALUATION EDUCATION

ITEM	DESCRIPTION
Controlling Water Erosion with Conservation Planning.	• 1988, 80 slides. • Soil erosion control. • Study guide and audio tape accompany.
Crop Science: A Laboratory Manual.	• 1988, 296 pages. • One chapter dealing with soils. • Text and discussion format; questions and answers interspersed; study questions at end of chapter; couple of diagrams.
Field Crop Nutrition—Applied Science Concepts.	• 1991, 160 pages. • One chapter dealing with soils. • Topics covered in great detail include nutrients and charges.
How to Design a Flower Garden	• Video, 48 minutes. • 8:59 minutes relating to soils. • Important points on screen; discussion of soil test—what it tells you, what to do with info gained from it, drainage—ways to check and handle, soil nutrients, pH, humus
How to Design a Vegetable Garden.	• Video, 58 minutes. • 11:42 minutes relating to soils. • Important points on screen; demo of soil test; discussion of drainage, pH, how to "fix" your soil, soil nutrients, fertility; beginner's perspective.
How to Grow Healthy Houseplants.	• 1986, video, 60 minutes. • 7:30 minutes relating to soils. • Important points on screen; discussion of particle size, different soil mixes for houseplants, how to pasteurize soil, soilless mix.

Improving Your Garden Soil.	• 1992, 112 pages. • Uses color!; diagrams; lots of photographs. • 1st section more generalized info, like what would be used in an Agr. Edu. program.
Introductory Soils Lab Manual.	• 1992, 106 pages. • Lab-oriented with experiments and pictures.
Judging Land and Soil for Agricultural Use.	• 1990, 35 pages. • Diagrams; color plates; pictures; review section; glossary; contest description.
Judging Land and Soil for Urban Use.	• 1986, 24 pages. • Color plates; diagram; scorecard; pictures; glossary.
Know Your Land.	• 1992, 56 slides. • Explain each section of scorecard; goes along with manual.
Nature and Properties of Soils.	• 1996, 740 pages. • College-level text; too detailed for HS level. • Graphs, pictures, photographs, descriptions. • Better as reference than main source.
Ohio Vegetable Production Guide.	• 1996, ? pages. • One section relating to soils; mostly text with some tables.
Probing Our Soils—Getting to the Roots of Agriculture.	• Laboratory kit. • Designed for K-8 grade levels. • Video training for teachers. • Covers pH, texture, particle size, layers, erosion.
Soil and Its Properties.	• 1988, 66 slides. • Goes along with manual.

Soil and Water Relationship.	• 1995, CD-ROM and accompanying manual. • Interactive computer program; organized as many small lessons, with evaluation assessments at completion of each topic. • Work at own pace and level; glossary after each section and accessible anytime. • Manual complete with screen content and added section on more detailed scientific background info • Many color pictures in program; music and narration used in addition to screen typing; "links" allowed access to almost any part of program from any location.
Soil Fertility Manual.	• 1992, 116 pages. • Focus more on nutrients than soil evaluation. • Suggested lesson plans included; good diagrams; review after each chapter; use of bold and bulleting for emphasis and organization.
Soil Science.	• 1990, 4 pages. • Lab-oriented, experiments for students. • Lesson plan format.
Turf Management.	• 1989, 109 pages. • Material arranged in easy-to-read manner; diagrams; student exercises involved taking field trips.
The Water Erosion Process.	• 1988, 80 slides. • Basic soil erosion; covers different kinds of erosion and includes equations. • Study guide and audio tape accompany.

APPENDIX II:

PRINCIPLES OF TEACHING AND LEARNING FOR VARIOUS EDUCATIONAL TOOLS FOR LAND & SOIL JUDGING

EDUCATIONAL TOOL	1	2	3	4	5	6	7	8	9	10	11	12	13
Experiments/labs	O, S, M	☺	N, I	X	☺	☺	☺	☺	X	☺	☺	☺	☺
Field trips	O, S, M	☺	W, N, I	X	X	X	X	X	X	☺	☺	X	X
Handouts	O, S	X	N	X	X	X	X	X	X	☺	X	X	X
Judging/contest	O, S, M	X	W, N	X	☺	☺	☺	☺	☺	☺	☺	☺	☺
Lecture	O, S	☺	N, I	X	X	X	X	X	X	☺	X	X	X
Manuals, textbooks	O, S	X	N	X	X	X	X	X	X	☺	X	X	X
On-line	O, S, M	☺	W, N, I	☺	☺	X	X	☺	☺	☺	☺	☺	☺
Oral reasons	O, S, M	☺	N, I, A	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
Overheads	O, S	X	N	X	X	X	X	X	X	☺	X	X	X
Peer mentoring	M	☺	N, I, A	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
Slides	O, S	X	N	X	X	X	X	X	X	☺	X	☺	☺
Software	O, S, M	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
Soils pits	O, S, M	☺	N	X	☺	☺	☺	☺	☺	☺	☺	☺	☺
Videos	O, S	X	N	X	X	X	X	X	X	☺	X	X	☺
Written evaluation	O, S	X	X	X	☺	☺	☺	X	X	☺	X	☺	☺

☺ = Learning tool format meets or exceeds qualifications for consideration under that principle.
X = Learning tool format does not meet qualifications for consideration under that principle.
O, S, M = Organization, Structure and Meaning, respectively, as described in Principle 1.
W, N, I, A = Wants, Needs, Interests and Aspirations, respectively, as described in Principle 3.

APPENDIX III:

ADVANTAGES AND DISADVANTAGES OF SOFTWARE USE AS A PRIMARY LEARNING TOOL FORMAT: A SYNOPSIS OF RESEARCH

BENEFITS OF SOFTWARE USE:	DISADVANTAGES OF SOFTWARE USE:
• Requires active response by student and gives info regarding progress; rapid reinforcement of correct answer (Stitzlein, 1972)	• Costs (Miller, Miller & Doerfert, 1995)
• Interactive: attention-keeper and high involvement (Stitzlein, 1972)	• Lack of training (Miller & Doerfert, 1995)
• Set own pace (Stitzlein, 1972)	• Incentives to use (Miller & Doerfert, 1995)
• Opportunity to make choices (Stitzlein, 1972)	• Shown to be as effective as normal lecture/discussion method (McCaskey, 1989)
• Designed to encourage higher thinking skills and greater global understanding—computer simulation game, "China Connection" (Fulbright, 1984)	• Access to equipment, etc (Sutphin, 1990)
• Learning by doing—Dutch erosion computer simulation (Beishuizen, 1992)	• Instructor and student level of comfort with computer technology; high level of computer anxiety (Shick, 1996)
• Learn the basics (Agricultural Education SimFarm™, 1995)	• Goofing off—taking advantage (Miller & Olson, 1995)
• Immediacy and individualization (Dyrli, 1996)	• "Technology does not solve all teaching-learning problems and may not even be effective in some situations" (Galliher, 1995)
• Bringing outside world into classroom (Technology & Education Standards Brief, 1996)	
• Obtain resources beyond what single school or district could provide (Technology & Education Standards Brief, 1996)	
• Individual instruction to match student level of achievement, interest, and/or ability (Stitzlein, 1972)	

APPENDIX IV:

MODEL FOR EFFECTIVE SOFTWARE FOR LAND AND SOIL JUDGING